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SOME FOSSIL CORALS FROM THE WEST INDIES

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IN THE United States National Museum are three small collections of fossil corals from the West Indies, containing a number of new or otherwise interesting forms: Two collections from the Upper Cretaceous and Eocene of Jamaica, made by Dr. C. T. Trechmann and Dr. C. A. Matley; and one from the Scotland beds of Barbados, made by Dr. Trechmann. These collections were sent at different times to Dr. T. Wayland Vaughan for determination, but as he was unable to work on them he turned them over for report to the author during his tenure of a Storrow fellowship of the National Research Council. A preliminary study was carried on under the direction of Dr. Vaughan at the Scripps Institution of Oceanography, and the final work done at the United States National Museum.

Material from a fourth lot, the Romanes collection from Barbados, was lent to the author through the courtesy of Dr. H. Dighton Thomas, of the British Museum (Natural History), and notes on this are included in the discussion of the Matley collection from Barbados.

Because the collection contains corals of different ages and from different areas, the report is divided into four parts as follows:

(1) The Trechmann and Matley collections from the Upper Cretaceous of Jamaica (p. 74); (2) the Trechmann collection from the lower Eocene Richmond beds of Jamaica (p. 93); (3) the Trechmann and Matley collections from the middle Eocene Yellow limestone of Jamaica (p. 94); (4) the Trechmann and Romanes collec-

tions from the Scotland beds of Barbados (p. 103). Notes on the occurrence of the corals are given preceding the first part and at the beginning of the last part.

The author is deeply indebted to Dr. Vaughan for his careful guidance in the study of these collections and for his extending to him the facilities of the Scripps Institution while working there. To the authorities of the United States National Museum he is indeed grateful for the full use of the splendid collections and the library facilities, and for making the photographs used in the plates.

Occurrence of the Upper Cretaceous and Eocene corals of Jamaica.—The specimens from the Upper Cretaceous come from beds to which Trechmann has assigned a Campanian (Maastrichtian?) age (the Catadupa beds of R. T. Hill). One series of specimens, all of *Trochocyathus matleyi*, new species, comes from near the top of Blue Mountain Peak from beds that have been shown by Matley (1929, p. 458) to be Upper Cretaceous. The two specimens from the lower Eocene in the Trechmann collection are from the Richmond formation, but these may be derived Cretaceous in origin, according to a note by Dr. Trechmann on the labels. The specimens in the Trechmann and Matley collections from the middle Eocene are from the Yellow limestone (the Cambridge formation of R. T. Hill). The stratigraphic relations of the Upper Cretaceous formations, the Richmond formation, and the Yellow limestone have been discussed by Trechmann in a series of recent papers (1922a, 1922b, 1923, 1924a, 1924b, 1929).

The Upper Cretaceous formations of Jamaica are now known to contain the following species and varieties of corals, including those described as new herein:

- Paracyathus* (?) sp. Trechmann, 1929.¹
- Trochocyathus matleyi*, new species.
- Dichococnia trechmanni*, new species.
- Rhabdophyllia quaylei*, new species.
- Cladocora jamaicensis* Vaughan, 1899.¹
- Dictyophyllia conferticostata* (Vaughan, 1899).
- Dictyophyllia conferticostata columnaris* (Vaughan).¹
- Stiboriopsis jamaicensis* Vaughan, 1899.¹
- Trochoscris catadupensis* Vaughan, 1899.
- Centrastraea hilli*, new species.
- Vaughanoseris catadupensis*, new genus and species.
- Cyathoseris haidingeri* Duncan, 1865 (*non* Reuss).^{1,2}
- Mesomorpha catadupensis* Vaughan, 1899.¹
- Favioscris anomalos*, new genus and species.

¹ Not found in either the Trechmann or Matley collections and so not discussed in this paper.

² A fragment from Duncan's specimen is in the National Museum. It does not show the structure of *Cyathoseris* but appears to be one of the colonial Leptophylliids in the neighborhood of *Sematethmos* Gregory.

- Leptophyllia agassizi* Vaughan, 1899.¹
Diplaraea (?) *boltonae*, new species.
Cyclolites jamaicacensis, new species.
Paracycloseris elizabethae, new genus and species.
Synastra (?) *adkinsi*, new species.
Prodiploastrea schindewolfi, new genus and species.
Multicolumnastra *cyathiformis* (Duncan, 1865).
Goniopora reussiana (Duncan, 1865).
Goniopora trechmanni, new species.

The following is a complete list, so far as is known to the author, of the species of corals from the Eocene of Jamaica:

LOWER EOCENE (Richmond beds):

- Stylophora contorta* (Leymerie) *vide* Duncan, 1865.¹
Stylophora species *a*.
Stylophora species *b*.
Astrocoenia duerdeni (Vaughan, 1899).¹
 ?*Columnastrea cyrei* Duncan, 1867.¹

MIDDLE EOCENE (Yellow limestone):

- Stylophora cambridgensis*, new species.
Astrocoenia jamaicacensis, new species.
Antillophyllia (?) sp.
Antilloseris cantabrigiensis (Vaughan, 1899).
Antilloseris jamaicacensis (Vaughan, 1899).
Antilloseris (?) sp.
Trochoseris (?) sp.
Eupsammia clarendonensis, new species.
Dendracis cantabrigiensis Vaughan, 1899.
Actinacis sawkinsi, new species.
Actinacis barretti, new species.
Astreopora walli, new species.
Goniaraea christianiaensis, new species.

¹ Not found in either the Trechmann or Matley collections and so not discussed in this paper.

CORALS FROM THE TRECHMANN AND MATLEY COLLECTIONS FROM
THE UPPER CRETACEOUS OF JAMAICA

Family CARYOPHYLLIIDAE Verrill

Genus TROCHOCYATHUS Milne Edwards and Haime, 1848

TROCHOCYATHUS MATLEYI, new species

PLATE 2, FIGURES 5, 6

Description.—Corallum small, without basal attachment, trochoid, straight, tapering regularly to the base. Calice shallow, with rounded margin. Wall thin, solid, formed by septal thickening. Septa slightly exsert, 48 in number, thin, regularly arranged, equal near the wall, but only those of the first two cycles extending to the columella, where they are terminated by a crown of thin, elongate pali. Septa of the third cycle terminating with a crown of pali just outside of the first palar crown. Septa of the fourth cycle very short, extending inward but a short distance from the wall. Septal margins entire, sides granulate. Columella poorly developed, composed of one or two processes. Dissepiments absent. Costae low, equal, subacute, corresponding to the septa and extending to the base. No epitheca.

Measurements.—As follows:

Specimen	Height		Calicular diameter
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1 (type).....	3.5		4.0
2 (paratype).....	4.0		4.5
3 (paratype).....	4.2		4.5

Type.—U.S.N.M. no. 74478.

Occurrence.—In a hard, calcareous, blue concretionary mudstone 300 feet below the summit of Blue Mountain Peak, Jamaica (Matley collection).

Remarks.—This species is distinguished by its small size and need only be compared with *T. woolmani* Vaughan (1900a, p. 436) from the Upper Cretaceous of New Jersey, a species having an attached corallum and fewer septa. *Paracyathus* (?) sp. Trechmann is also an attached form and has a larger corallum.

Family EUSMILIIDAE Verrill

Genus DICHOCOENIA Milne Edwards and Haime, 1848

DICHOCOENIA TRECHMANNI, new species

PLATE 2, FIGURES 7, 8

Description.—Corallum massive, tuberous or bulbous in form. Corallites protuberant above the general surface to a height of 3 mm or more, originally cylindrical in form, but usually distorted by fission to an ovate or elliptical shape. Corallites united by costae and a well-developed exotheca; on the surface of the intercorallite areas the costae are distinct, their upper margins covered by single rows of granulations. Calices shallow, varying in diameter from 3 mm in the more circular ones to 3 by 4.5 mm in the more elongate and 3 by 7 mm in those undergoing fission. Septa thick, regularly alternate in size, slightly exsert, upper margins entire, lightly granulate laterally. In circular calices there are regularly three complete cycles, the first and second extending to the columella. In the distorted calices portions of the fourth cycle are often developed. Septa much thickened distally to form the corallite wall. Columella spongy, well developed but not prominent, and appearing lamellar in the elliptical calices. Endotheca not abundant.

Measurements.—As follows:

Specimen	Height	Maximum thickness
	Mm	Mm
1 (type)-----	62	38
2 (paratype)-----	70	44
3 (paratype)-----	30	31

Type.—U.S.N.M. no. 74480.

Occurrence.—In the rudistid limestone of the Logie Green section; and in the limestones near Catadupa, Jamaica (Trechmann collection).

Remarks.—This species is particularly interesting because it extends the range of the genus *Dichocoenia* back into the Mesozoic in the West Indian region. It differs from *D. alabamensis* Vaughan (1900b, p. 139) from the Midwayan Eocene by the lack of development of the exotheca and the resulting close union of the corallites in the latter species. *D. tuberosa* Duncan (1863, p. 432) from the West Indian Miocene possesses pali and is a larger species. The living West Indian species, *D. stokesi* Milne Edwards and Haime,

has calices that project but slightly and are considerably elongated, with low, rounded, strongly echinulate costae, and pali before the first three cycles of septa.

Stenosmia de Fromentel (1870, p. 383), species of which occur in the Upper Cretaceous of Europe, is very close to, if not identical with, *Dichocoenia*. *D. treckmanni* closely resembles *S. proletaria* Oppenheim (1930, p. 437) from the Senonian of Austria (Gosau), but the costae are not so strong, the corallites are more protuberant, and the septa are more numerous in the Jamaican form.

Family FAVIIDAE Gregory

Genus RHABDOPHYLLIA Milne Edwards and Haime, 1851

Gregory (1930, pp. 102-103) discusses the relationships of *Rhabdophyllia*, *Aplophyllia*, and *Cladophyllia* and finds that the only difference between the first two genera lies in the incomplete costae of the second as compared with the complete costae of *Rhabdophyllia*. He accordingly proposes to consider *Rhabdophyllia* a synonym of *Aplophyllia* d'Orbigny, 1849, because the latter has priority. Duncan (1884, p. 80) considered them identical but dropped d'Orbigny's name for the better known *Rhabdophyllia*. For the present, however, I should keep the two genera separate. *Rhabdophyllia* is very close to *Calamophyllia* but possesses a better-developed columella and lacks the accretion ridges or collarettes of the latter. The species described below has occasional encircling ridges resembling collarettes, but they lack the regularity of *Calamophyllia*.

RHABDOPHYLLIA QUAYLEI, new species

PLATE 2, FIGURES 3, 4

Description.—Corallites tall, cylindrical, or irregularly rounded in section, with an average diameter of 12.5 mm, dichotomous, increasing by fission, the new corallites projecting upward and outward at a slight angle from the parent corallites. Corallite walls solid, costate, without an epitheca. The costae alternate in size, corresponding to the septa, their margins being acute and granulate. The septa are variable in number within the calices because of fission but are more or less constant within the cylindrical corallites; in a calice measuring 9 by 17 mm there are 81; in a corallite measuring approximately 10 mm in cross section there are 60. They are about equal in thickness and regularly alternate in length, so that one-half of them extend to the center and unite with the columella. They are laterally granulate and are dentate on their upper margins. The columella is well developed, spongy, formed by the entangling of

the trabeculae of the inner ends of the septa. Endothecal dissepiments well developed.

Type.—U.S.N.M. no. 74481.

Occurrence.—Four specimens are from the base of the rudistid limestone, where it overlies the Trappean shales about midway between Cambridge and Catadupa in the railway cut, Jamaica (Trechmann collection).

Remarks.—This species is distinguished by the unusually large number of septa and relatively large corallites. It is close to *R. nutrix* de Fromentel from the Senonian of France, a species having slightly smaller corallites and fewer septa. Gerth (1928, p. 5) has described as *Rhabdophyllia* sp. a form from the Upper Cretaceous of Curaçao—from beds that he considers equivalent to those from which the present species comes—which may be very close to, or identical with, the present species, although he says that an inner (dissepimental) wall separates it from other Upper Cretaceous species of the genus.

Genus DICTUOPHYLLIA Blainville, 1830

DICTUOPHYLLIA CONFERTICOSTATA (Vaughan)

Diploria conferticostata VAUGHAN, 1899, p. 239, pl. 39, figs. 1-3.

Leptoria conferticostata VAUGHAN, 1919, p. 194.

Leptoria conferticosta FELIX, 1925, p. 90.

Diploria crassolamellosa DUNCAN, in Duncan and Wall, 1865, pp. 7, 12; 1868, p. 24.

Idotype.—U.S.N.M. no. 74477.

Occurrence.—The four specimens in the Trechmann collection are from the following localities in Jamaica: Rudistid limestone, below Catadupa Station; limestone, Cambridge-Catadupa railway cut; dark limestone near igneous intrusion, Mooretown.

Remarks.—This species has been adequately described and figured by Vaughan (1899). The specimens from the Trechmann collection are in close accord with Vaughan's description and figures. They are all rounded, subglobose forms with the following measurements:

Specimen	Height	Length	Width
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1.....	75	90	72
2.....	45	54	42
3.....	30	56	53
4.....	75	39	45

Vaughan noted a very close comparison between this species and *L. flexuossissima* (d'Achiardi) from the Eocene of San Giovanni

Ilarione, Italy, the main differences between the two being the wider valleys, equal septa, and knoblike fused inner ends of the septa on either side of the columella in the Eocene form; but it is probably more closely related to *L. reticulata* (Goldfuss) from the Maastrichtian of St. Petersburg, as it has been recently described and figured by Umbgrove (1925, pp. 107, 108). In this species the valleys are about 1 mm in width, with the same width for the collines, and the septa number 70 to 100 to the centimeter. *L. konincki* Milne Edwards and Haime and *L. delicatula* Reuss from the European Senonian are both separated from the Jamaican species by the lack of costate grooves between the walls.

Family AGARICIIDAE Verrill

Genus TROCHOSERIS Milne Edwards and Haime, 1849

TROCHOSERIS CATADUPENSIS Vaughan

PLATE 2, FIGURES 9, 10

Trochoseris catadupensis VAUGHAN, 1899, p. 242, pl. 39, figs. 5, 6; 1919, pp. 194, 426.—FELIX, 1925, p. 120.

?*Trochosmia hilli* VAUGHAN, 1899, p. 233, pl. 36, figs. 1-4.

Occurrence.—Specimen 1 comes from the limestone near Catadupa; specimen 2, which possesses two calices, the result of budding, is from a locality near Catadupa; specimen 3 is from a shale that underlies the rudistid limestone and that is the equivalent of the Providence shales near Port Antonio, in the railway cut between Cambridge and Catadupa (Trechmann collection). Vaughan's type specimen came from near Catadupa.

Remarks.—Five specimens from the Trechmann collection are referred to this species. Three of them, mentioned above, fit Vaughan's description very well. Their measurements are as follows:

Specimen	Height	Basal diameter	Calicular diameters
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1.....	11.....	6.....	17 by 17.
2.....	20.....	7 by 9.....	14 by 17, 13 by 16.
3.....	16.....	7.....	14 by 21.5.
Vaughan's type.....	19.5.....	13.5 by 15.

Notes on other specimens.—Two other specimens that almost certainly belong to this species are much larger and more mature forms. The following is a description of the better-preserved specimen:

The corallum is simple, arising from a small pedicellate base, rapidly expanding, the calice flaring out unequally with an undulate margin. The outer surface is covered to the base by low, acute costae, which regularly alternate in size, marked by single rows of granulations. The wall between them is imperforate and solid, its upper margin where it meets the reflexed calice. On one side of the corallum is attached a young compressed individual, which has been budded off. The calice is convex near the outer margin, but becomes deep and concave centrally, with a very small, deep fossette. The septa are very numerous, thin, crowded, irregularly arranged in six complete cycles and part of the seventh. They are solid, laterally granulated, lightly beaded on the upper edges, unequal in length and thickness. About 18 of the thickest and longest septa reach to the center of the fossette and join the columella. The columella is very small, deep in the fossette, with a papillose upper surface.

Measurements.—As follows:

Specimen	Height	Basal diameter	Calicular diameters
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
4.....	43	4	42 by 50
5.....	26	10	28 by 32

Plesiotype.—U.S.N.M. no. 74491.

Occurrence.—Specimen 4 comes from a locality near Catadupa; specimen 5 is from the equivalent of the Providence shales in the Cambridge-Catadupa railway cut (Trechmann collection).

Remarks.—The specimen just described is illustrated on plate 2, figures 9, 10.

A sixth specimen, referred with some doubt to this species, comes from the rudistid limestone in the Logie Green section. It differs from the other forms by the presence of an elongate columellar fossette, but in all other respects is like them. The corallum has been badly worn and measures 31 mm high and 37 by 63 mm in calicular diameters.

Trochosmilia hilli Vaughan may be a synonym of this species, although Vaughan points out that the sides of the costae are perpendicular and that the columella is absent, whereas in *Trochoseris catadupensis* the costae are acute or rounded. These are the only observable differences between the two forms. The columella in *T. catadupensis* is usually very small and deep in the calice and is rarely visible even in the larger specimens.

Genus *CENTRASTREA* d'Orbigny, 1849*CENTRASTREA HILLI*, new species

PLATE 2, FIGURES 11, 12

Description.—Corallum thin, encrusting, 1 to 2 mm thick. The type specimen is 37 mm long and 21 mm wide. The corallites are small, short, and united by septo-costae, which are very short, thick, and rounded, and confluent between calices. The exotheca may fill the costal interspaces and give the appearance of a thick corallite wall when the specimen is worn. The calices are shallow, with an average diameter of 0.75 mm and a distance of 0.7 to 1 mm between centers. The septa are 12 in number, thick, laminar, and arranged in two cycles, the first of which reaches the center and joins the columella. They are much thickened near the calicular margins, and are united by a few synapticalae and well-developed endotheca. The columella is styliiform, not prominent in the calices, and free within the corallites.

Type.—U.S.N.M. no. 74492.

Occurrence.—From a locality near Catadupa, Jamaica (Trechmann collection).

Remarks.—The single specimen upon which the foregoing description is based is a much-worn fragment, and the determination of the structure is very difficult.

This species is distinguished from other Upper Cretaceous species of the genus by the very small, close-set calices, and it seems to be nearer to the Neocomian species *C. microphyllia* d'Orbigny figured by de Fromentel (1887, pl. 185, fig. 2). In that species, however, the septa number 16, octamerally arranged.

VAUGHANOSERIS, new genus

Generic diagnosis.—Corallum simple, free, low, and depressed-conical in shape, with a shallow circular or elliptical calice having a deep, elongate central columellar fossette. Septa laminar, imperforate, not uniting, lightly dentate on their upper margins, and laterally granulate. Wall indistinct, formed by synapticalae and endotheca, perforate. Septo-costae thin, beaded on their edges, united by exotheca and some synapticalae, covered by a very thin, easily eroded epitheca. Columella spongy, essential. Endotheca present. Synapticalae present, mostly near the wall.

Genotype.—*Vaughanoseris catadupensis*, new species, from the Upper Cretaceous near Catadupa, Jamaica.

Remarks.—Specimens of this genus, which groups with the Agariicidae, look very much like young specimens of *Antillophyllia*, but the perforate wall and presence of synapticalae are indicative of its

fungid nature. It is most closely related to *Podoseris* Duncan, a genus possessing the same general structure but differing by being an attached form with uniting septa and a rudimentary papillary columella. It differs from *Antilloseris* Vaughan by having a thin epitheca, dissepiments, and a columella. *Microsmilia* Koby has a fasciculate columella, lacks dissepiments, has a folded or reflexed wall, as in *Trochoseris*, and is sessile in habit.

VAUGHANOSERIS CATADUPENSIS, new species

PLATE 3, FIGURES 11-13; PLATE 5, FIGURE 3

Description.—Corallum simple, low, depressed conical in shape, slightly elliptical in outline, with a small central, nipple-shaped scar of early attachment on the base. The exterior is partially covered by a thin epitheca, which is easily eroded away and through which the septo-costae are distinct. The septo-costae are acute, equal, thin, beaded on their edges, and united by a well-developed exotheca and a few synapticulae. The wall is indistinct, irregularly perforate, dissepimental in origin, and separated from the epitheca by the exotheca, which may be as much as 1 mm in thickness. The calice is shallow, with a central elongate columellar fossette. The septa are imperforate, exsert, laminar, straight, not uniting inwardly, and arranged in 6 complete cycles (192 septa). Those of the first and second cycles are equal, lightly dentate on their upper margins, laterally granulated in close vertical rows and extending to the columella. The remaining septa are regularly shorter and thinner according to their cycle, with their upper margins notched by strong teeth. The columella is spongy, well developed, filling the bottom of the fossette. The synapticulae are not numerous, occurring mostly near the wall. Endotheca present but not abundant.

Measurements.—As follows:

Specimen	Height	Calicular diameters	Depth of fossette
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1 (type).....	15	30 by 32	3.8
2 (paratype).....	13	28 by 31	4.2

Type.—U.S.N.M. no. 74485.

Paratype.—U.S.N.M. no. 74486.

Occurrence.—Specimen 1 is from a locality near Catadupa; specimen 2 comes from the equivalent of the Providence shales underlying the rudistid limestone in the Cambridge-Catadupa railway cut (Trechmann collection).

FAVIOSERIS, new genus

Generic diagnosis.—Corallum massive, tuberous, pedunculated. Corallites slightly protuberant, cylindrical, or deformed by fission, united by septocostae. No true corallite wall, but a ring of well-developed synapticulae forms a perforate boundary. Septa thin, imperforate, laminar, beaded on the upper edges, thickened peripherally near the thecal ring, continuous with the septocostae, which are trabeculate and perforate, the perforations tending to become filled up. The upper edges of the costae are rounded and beaded. Columella absent, the axial space being quite empty. Dissepiments not well developed. Reproduction by fission.

Genotype.—*Favioseris anomalos*, new species, from the Upper Cretaceous limestones of Jamaica.

Remarks.—The family position of this genus is somewhat uncertain because its general features are those of the Oulastreids, although the septal structure is close to the Anabaciids in spite of the laminar septa, which are more characteristic of the Agariciids. The Oulastreids, however, increase by gemmation, whereas fissiparity is very marked in *Favioseris*. The laminar condition of the septa seems to be due to subsequent filling of the original perforate trabecular framework—a process that has not proceeded so far in the septocostae as in the septa. No genus of the Anabaciidae seems close to this form. *Siderofungia* Reis is perhaps related, but the walls of that genus are very poorly developed and the calices have the habit of *Siderastrea*. *Crateroseris* Tomes is supposed to have imperforate septa and septocostae and therefore groups with the Agariciidae, but, as Gregory (1900, p. 189) has pointed out, this apparent imperforate condition may be quite the opposite, in which case *Crateroseris* would be near *Dimorpharaca* and *Polyphyllastrea*. *Crateroseris* as it is now understood is near *Favioseris*, except that it increases by gemmation and has more protuberant corallites. For the present *Favioseris* is placed in the Agariciidae.

FAVIOSERIS ANOMALOS, new species

PLATE 4. FIGURES 19, 20

Description.—Corallum massive, tuberous, arising from a narrow base. The calices are slightly protuberant, not bounded by a true corallite wall, the margins being formed by the thickened outer ends of the septa and a ring of synapticulae, as in the Oulastreids and *Siderastrea*. They are originally circular in outline but are usually oval or elliptical, owing to the fissiparous mode of increase. The diameter of the circular calices averages 3 mm, that of the elongate

ones 2.5 by 4.5 mm. Within the calices the septal margins fall evenly but steeply to the central fossette, the bottom of which is about 1.2 mm below the calicular margins, or 1 mm below the intercorallite areas. The surface between the corallites averages 1.5 mm in width and is crossed by the confluent septocostae, whose upper margins are heavily beaded, owing to their trabeculate-fenestrate structure. The septa are imperforate, laminar, thickened peripherally, thinner toward the center, not extending to the center of the corallite, and laterally granulated with the upper margins dentate. In a circular calice there are regularly 24 septa, 12 of which are longer than the rest and reach to the edge of the fossette, which they bound; in larger calices up to 45 septa can be counted, all regularly alternating in length. There is no columella. The synapticulae are developed only in the peripheral region of the corallites. Between corallites there is some exotheca but there is no endotheca within them.

Measurements.—The holotype is 55 mm high, 32 mm in maximum diameter, and 16 mm in diameter near the base.

Holotype.—U.S.N.M. no. 74484.

Occurrence.—In the limestones near Catadupa, Jamaica (Trechmann collection).

Remarks.—This species may be distinguished from *Synastraea* (?) *adkinsi* by its imperforate septa, by the presence of a synapticular corallite wall, and by the fissiparous mode of increase.

Family LEPTOPHYLLIIDAE Vaughan

Genus DIPLARAEA Milaschewitsch, 1876

DIPLARAEA (?) BOLTONAE, new species

PLATE 2, FIGURES 1, 2

Description.—Corallum subcylindrical, compressed near the base, expanding upwardly, subdividing into several corallites, which remain closely united in a single series, separated by constrictions of the corallite wall and joined inwardly by short, confluent septocostae. Between the base and top of the corallum the exterior is marked by irregular expansions, and in the type specimen midway between base and top is a small protuberant corallite that has been produced fissiparously and has remained separate. The exterior is covered by a very thin, easily eroded epitheca, through which the septo-costae are seen. The latter are rounded, subequal, and beaded on their edges. Between them and extending to the wall are well-developed exothecal dissepiments. The wall is perforate, indistinct, and composed of synapticulae and dissepiments. The calices are shallow and very irregular in outline. There are three on the top

of the type, serially arranged, united directly by the septo-costae, any intercorallite wall being absent. The septa are slightly exsert, laminar, irregularly perforate as in *Leptophyllia*, thin, equal, laterally granulated, united by endotheca and synapticalae. In one calicular center, 8 by 10 mm, there are 60 septa, all of which extend to the columella. The columella is parietal, moderately developed, spongy in appearance in the calices but not prominent when seen in cross section.

Measurements.—The holotype measures: Height, 42 mm; basal diameters, 8 by 10 mm; diameters 10 mm below calices, 12 by 23 mm; length and width of series, 29 by 6-12 mm.

Holotype.—U.S.N.M. no. 74479.

Occurrence.—From a locality near Catadupa, Jamaica (Trechmann collection).

Remarks.—This species fits the generic characters of *Dermosmilia* as discussed by Koby (1889, p. 546). Ogilvie (1897, p. 258) later considered Koby's genus a synonym of *Diplaraea*. Koby does not mention the condition of the wall in *Dermosmilia*, but Ogilvie states that a true wall is not present, but that septal thickening and exothecal development form an outer wall. In the present species the septal thickening is not apparent, the septa being of nearly equal thickness throughout, and the entire structure of the corallum is like *Physoseris* Vaughan (1905, p. 396), except for the colonial form of the corallum. All the species at present referred to *Diplaraea*, except *D. venezuelensis* Gregory, are from the Upper Jurassic, although its nearest relation, *Haplaraea* Milaschewitsch, a solitary form, occurs also in the Senonian of Europe (Oppenheim, 1930, p. 26 ff.). *D. venezuelensis* Gregory (1927, p. 441), from the Urgonian of eastern Venezuela, is a species with larger branches and more septa, only a part of the latter, however, reaching to the columella.

Family ANABACIIDAE Duncan

Genus CYCLOLITES Lamarck, 1801

CYCLOLITES JAMAICAENSIS, new species

PLATE 3, FIGURES 1-4

Description.—Corallum simple, free, circular or slightly elliptical in outline, flat on the base or slightly concave, convex above, with a circular fossette 2 to 3 mm in depth. Wall of corallum horizontal, indistinct. The base is covered by a thick, concentrically wrinkled epitheca. The septa are numerous, thin, straight, not uniting, trabeculate, and fenestrated, those of the first three cycles, which

are slightly thicker than the rest, being almost imperforate and laminar, owing to the filling up of the pores. In mature specimens there are six complete cycles of septa and a good part of the seventh. There is no columella. The synapticulae are well developed, particularly in the lower part of the corallum.

Measurements.—As follows:

Specimen	Height	Basal diameters
	<i>Mm</i>	<i>Mm</i>
1 (paratype).....	6	23 by 27
2 (paratype).....	9	24.5 by 28
3 (paratype).....	11.5	31 by 34
4 (paratype).....	16	32 by 33.5
5 (type).....	14	28 by 28.5
6 (paratype).....	13	22.5 by 26
7 (paratype).....	11	22 by 23

Type.—U.S.N.M. no. 74488.

Occurrence.—All the specimens come from the Providence shales at Providence, near Port Antonio, Jamaica (Trechmann collection).

Remarks.—This is the first species of this important and widespread Cretaceous genus to be noted from the West Indian or North American areas. It groups with *C. hemisphaerica* Michelin (*non* Lamarck, 1801)³ of the Senonian of Europe, and is most closely related to *C. ligeriensis* Milne Edwards and Haime (Fromental, 1870, p. 360) from the French Senonian, and from which it may be distinguished by its larger number of septa (about 124 in *C. ligeriensis*, *vide* de Fromental; 192 to 250 in *C. jamaicaensis*), coralla of about the same size.

PARACYCLOSERIS, new genus

Generic diagnosis.—Corallum simple, free with scar of early attachment, depressed-conical to plano-convex in shape, circular in outline, the lower surface covered by a strong, concentrically wrinkled epitheca. Calice shallow or superficial, the latter condition occurring in younger specimens, with an oval or elongate fossette. Wall of corallum indistinct. Septa numerous, uniting as in *Cycloseris*, trabeculate-fenestrate in structure, usually with the pores well filled, particularly in the larger septa, upper edges marked by strong, almost lacerate teeth. Columella strong, well developed, essential, composed of numerous papillae. Synapticulae present

³ Milne Edwards and Haime, aware that this species was not identical with Lamarck's species, placed it in the synonymy of *C. discoidea* (Goldfuss), but Felix, in 1903, pointed out that it does not belong to Goldfuss' species and retained Michelin's name for it. Oppenheim, in 1930, proposed the name *C. michelini* for the species.

within the corallum near the edges of the calice. Dissepiments absent.

Genotype.—*Paracycloseris elizabethae*, new species, from the Upper Cretaceous of Jamaica.

Remarks.—The septal arrangement of this form is distinctive and much the same as that of many species of *Fungia* (*Cycloseris*-form). The septal structure is no less distinctive—the septa of the lower cycles are very similar to the laminar septa of the Agariciids except for the large teeth, which are of a type more often found in the Fungiids. The relationship with the Anabaciidae is shown in the structure of the septa of the higher cycles—the trabeculate-fenestrate or latticework arrangement of the trabeculae characteristic of *Anabacia* and *Microsolena*. The genus is not, however, closely related to any of the simple genera of this family, except *Cyclolites*, from which it is distinguished by the presence of a well-developed columella and less perforate, uniting septa. *Anabacia* lacks an epitheca and a columella, as does also *Trochoplegma*. *Trocharaea* has a parietal columella but no epitheca.

This form may be intermediate between the Mesozoic Cyclolitids and the modern Fungiids, possessing as it does many of the characters of both *Cyclolites* and *Cycloseris*.

PARACYCLOSERIS ELIZABETHAE, new species

PLATE 3, FIGURES 5-10; PLATE 5, FIGURES 1, 2

Description.—Corallum simple, free, circular in outline, flat or convex on the base, convex or concavo-convex above, with a shallow elliptical fossette in the more mature specimens. The lower surface is covered by a stout, concentrically wrinkled epitheca, to the central point of which, in the smaller specimen, is attached a foraminifer. The septa are numerous, upwardly arched, uniting, mainly imperforate with the upper margin dentate, laterally spinulose or granulate. There are six complete cycles and part of the seventh. Those of the first two cycles are equal, much thicker than the rest, extending to the columella, their upper edges set with coarse, lacerate, multitrabeculate teeth, which increase in size toward the center. The septa of the third cycle, while prominent, are much smaller than those of the first two, their upper edges being set with smaller teeth, but they extend to the columella. The arrangement of the remaining cycles is distinctive. The septa of the fourth cycle, instead of being inwardly fused to those of the *third*, are fused to the septa of the *fifth* cycle, which are nearest the primaries and secondaries, and the remaining septa of the fifth cycle join those of the fourth near the latter's junction with the first set of septa

of the fifth; the inner ends of the fifth cycle—that is, those nearest the primaries and secondaries—are fused to the third cycle near the columella; the sixth cycle fuses to the fifth, and those of the seventh, which are developed near the primaries, fuse to the sixth. The structure of the septa is trabeculate-fenestrate, the pores being filled up below, and perforations, except of the upper parts of the septa of the higher cycles, are rare. The columella is well developed, essential, elongate, completely filling the fossette, with a papillose upper surface. Synapticulae are present mainly in the peripheral region. The wall is indistinct. There are no dissepiments.

Measurements.—As follows:

Specimen	Height	Diameter	Depth of fossette
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1 (type).....	10	29.5	2.7
2 (paratype).....	3.5	26	0

Type.—U.S.N.M. no. 74489.

Occurrence.—From a locality near Catadupa, Jamaica (Trechmann collection).

Remarks.—Specimen 2 is an immature one, in which the corallum is discoid or plano-convex (pl. 3, figs. 8, 9); the septa are much thinner and more finely denticulate than in specimen 1, upon which the foregoing description was mainly based.

Genus SYNASTREA Milne Edwards and Haime, 1848

SYNASTREA (?) ADKINSI, new species

PLATE 3, FIGURES 14, 15

Description.—Corallum massive, tuberous, increasing in size by superposition of concentric layers about 5 mm thick, the exposed margins of these layers being covered by a thin epitheca. The calices are distinct, close-set, nearly always separated by an intercorallite groove. Where they are separated to any extent they are circular in outline, where close-set they are polygonal. The average diameter within the margins is 2.75 mm; the distance between centers varies from 5 to 6.5 mm; the maximum height of the margins above the intercorallite grooves is about 0.3 mm; the average calicular depth is 0.75 mm, but is often increased by weathering. There is no corallite wall, and the septocostae are confluent. The septa, 40 to 60 in number, comprise four complete cycles and parts of the fifth. In structure they are trabeculate-fenestrate near the surface,

becoming more or less filled up below and appearing lamellar in longitudinal section as the trabeculae lose their individuality. The septa of the first two cycles are much thicker and more prominent than the rest. The columella is well developed, spongy, and papillose on the surface. The dissepiments are absent, but there is a great development of the synapticulae.

Measurements.—Corallum measures: Height, 51 mm; diameter near base, 15 mm; maximum diameter between base and upper surface, 32 mm.

Holotype.—U.S.N.M. no. 74483.

Occurrence.—Upper Cretaceous limestone in the railway cut between Cambridge and Catadupa, Jamaica (Trechmann collection).

Remarks.—The calicular surface of this species closely resembles the typical Anabaciids, but the change in the structure of the septa from trabeculate-fenestrate to more or less laminar is very pronounced, resembling the structure found in *Astraraea* Felix, but the wall of the corallum in this genus is solid, imperforate, and costate (as it is in *Trochoseris* Milne Edwards and Haime); at least this is true of specimens labeled *Astraraea media* in the National Museum in a collection of the Gosau corals from Prof. Felix. *Synastrea agaricitis* (Goldfuss), type of the genus, also from the Gosau beds, specimens of which are in the National Museum, agrees more nearly with *adkinsi* from the standpoint of structure and character of the exterior, although the filling up of the lower parts of the septa is not so pronounced. The distinct calices of this species also distinguish it from other species of *Synastrea*, most of which have shallow calices not bounded by a distinct groove, as in *Thamnasteria* Lesauvage.

Family OULASTREIDAE Vaughan

PRODIPLOASTREA, new genus

Generic diagnosis.—Corallum massive, astreiform, forming a rounded pedunculate mass. Corallites cylindrical, of medium size, projecting slightly above the common surface, united by confluent septo-costae and a thin, well-developed exotheca. Septa not numerous, thin, little exsert, not uniting, continuous with the septo-costae, laminar in structure, very little perforate, and lightly dentate on the upper edges. Corallite wall porous, synapticular in origin. Synapticulae poorly developed except in the thecal ring. Endotheca scanty. Columella absent or very rudimentary. No pali.

Genotype.—*Prodiploastrea schindewolfi*, new species, from the Upper Cretaceous of Jamaica.

Remarks.—This genus is created to receive a species from the Trechmann collection that is closely related to *Diploastrea* Matthai, *Oulastrea* Milne Edwards and Haime, and *Cyathomorpha* Reuss, but which differs from all these, as well as from *Brachyphyllia* Reuss and *Pseudofavia* Oppenheim, by the lack of a well-developed columella. A more or less well-developed essential columella is present in the five genera mentioned. The septa and septo-costae are also unusually thin and comparatively few in number for members of this family, and there is but a slight thickening of the septa in the vicinity of the walls. The condition of the upper edges of the septa is not well shown in the specimen, but the septa are lightly dentate and lack pali or paliform lobes such as are found in *Cyathomorpha* and *Oulastrea*. *Diploastrea* has strong septal teeth or notches, but lacks pali. *Brachyphyllia* has numerous septa, which unite or fuse inwardly, and a well-developed columella.

PRODIPLOASTREA SCHINDEWOLFI, new species

PLATE 4, FIGURES 21, 22

Description.—Corallum subspherical, pedunculate. Corallites cylindrical, projecting, united by confluent septo-costae and a thin exotheca. On the surface between the corallites the septo-costae are thin, wavering, with rounded beaded edges. The calices are circular, bounded by a thin, well-defined, perforate synapticular wall, rather deep, crateriform, with an average diameter of 3.5 mm, although they may be as small as 2.5 mm. They are but slightly elevated above the intercorallite areas on the upper surface of the corallum, becoming higher on the sides and toward the base, the average distance between them being 3.25 mm. The septal arrangement is irregular, there being 24 to 32 septa, depending on the size of the corallite. They are thin, laminar, imperforate, regularly alternating in length so that half of them extend nearly to the center of the corallite, slightly exsert, lightly dentate on their upper margins, which descend rapidly to the bottom of the calice. There is no true columella, although the inner edges of a few of the larger septa may meet to form a straggly parietal axis. Endotheca scarce. Synapticulae well developed only near the wall. Exotheca well developed.

Holotype.—U.S.N.M. no. 74476.

Occurrence.—In the limestone of the Upper Cretaceous in the Cambridge-Catadupa railway cut (Trechmann collection).

Family ACROPORIDAE Verrill

Genus MULTICOLUMNASTRAEA Vaughan, 1899

MULTICOLUMNASTRAEA CYATHIFORMIS (Duncan)

Heliastrea exsculpta DUNCAN (*non* Reuss), in Duncan and Wall, 1865, pp. 7, 8, 11; 1868, p. 24.

Heliastrea cyathiformis DUNCAN, in Duncan and Wall, 1865, pp. 7, 8, pl. 1, figs. 1a, b; 1868, p. 24.

Multicolumnastrea cyathiformis VAUGHAN, 1899, p. 236, pl. 38, fig. 1; 1919, pp. 194, 486.—FELIX, 1925, pp. 252-253.

Occurrence.—In the rudistid limestone in the Logie Green section, Jamaica (Trechmann collection).

Remarks.—One very poorly preserved specimen from the Trechmann collection is referred to this species. It is a low-branching corallum with short stubby branches, which are usually compressed, with average diameters of 8 by 10 mm, closely packed together. The corallites are somewhat smaller than in the specimens described by Vaughan. Vaughan gives an average diameter of 2 mm, whereas in the specimen examined by the author they are rarely more than 1.25 mm. The intercorallite areas are crossed by the septo-costae when the corallites are close together; when they are distant the costae merge into a porous, reticulated coenenchyme.

Gerth (1928, p. 3) has described a species of this genus, *M. parvula*, from the Upper Cretaceous of Curaçao, which has calices not over 1 mm in diameter.

Vaughan (1919, p. 486) states that *Multicolumnastrea* is very close to *Actinacis*, the main point of distinction being the presence of several coarse columellar tubercles in the former.

Family PORITIDAE Dana

Genus GONIOPORA Blainville, 1830

GONIOPORA REUSSIANA (Duncan)

PLATE 4, FIGURE 18; PLATE 5, FIGURES 4, 5

Porites reussiana DUNCAN, in Duncan and Wall, 1865, p. 8, pl. 1, fig. 2; 1868, p. 25.—VAUGHAN, 1899, p. 249.

Goniopora jamaica 1 BERNARD, 1906, p. 159.

Plesiotype.—U.S.N.M. no. 74490.

Occurrence.—In the Upper Cretaceous limestones in the Cambridge-Catadupa railway cut, Jamaica (Trechmann collection).

Remarks.—One specimen from the Trechmann collection is a good example of this poorly known species. The form of the corallum and size of the calices agree well with Duncan's description.

Vaughan (1899), after repeating Duncan's original description, adds:

The usual number of cycles of septa is three; the arrangement into cycles does not appear perfectly regular and uniform, so Duncan's figures must be used with a qualification. In the best preserved portions there is no granulate area on the summit of the wall between the ends of the septa. Apparently the upper edge of the wall is acute in perfect material. Diameter of the calices 2.5 to 4 mm; the usual diameter is slightly less than 3 mm. The specimen does not permit the details of the pali (?) to be made out. It seems quite probable that the species is a *Litharaca*, and not *Porites*.

Bernard in his discussion (1906) adds practically nothing to our knowledge of this species, but questions whether the supposed type in the Museum of the Geological Society of London is the same as the specimen figured and described by Duncan in 1865, adding (p. 160): "There is not a character in the drawing [Duncan's] which agrees in the remotest with the calices of the specimen."

Details regarding the structure of this species can now be added from the well-preserved specimen in the Trechmann collection. The walls between the calices, where they are acute, are marked by a single row of granulations, but where there is some separation, the walls are rounded and may have 2 to 4 rows of granules. The septa are almost always 20 in number, arranged in a modification of the typical septal formula of the recent members of the genus that have 24 septa, as it is given by Bernard (1903, p. 21); this is best explained by plate 5, figures 4 and 5, representing the formulas of recent *Goniopora* and *G. reussiana*. There are three trabecular elements between the wall and a palus. There are five tubercular pali. The columella consists of a single tubercle surrounded below the floor of the calice by a ring of synapticulae uniting the palar trabeculae. The under surface of the corallum, where exposed by the superposed, laminar growth layers, is covered by a thin epitheca.

Measurements.—The diameters of the branches of the specimen are 12 by 15, 11 by 13, and 11 by 15 mm.

GONIOPORA TRECHMANNI, new species

PLATE 3, FIGURES 16, 17

Description.—Corallum massive, with a flat or concave base, growing upward by the addition of superimposed layers into a hemispherical or subspherical mass. The corallites average 1.8 mm in diameter and are embedded in a porous reticulate coenenchyme 0.5 to 1.5 mm apart. There is no definite corallite wall, and the outer ends of the septa merge with the coenenchyme. The calices are polygonal in outline, of moderate depth, bounded by a rounded reticular intercalicular ridge. The septa are well developed, always

12 in number near the columella, but frequently branching near the periphery so that the original number of septa may have been as many as 16. They are equal in size, thin, irregularly perforated, with their inner ends ending abruptly, leaving an axial space about 0.5 mm in diameter, which is partially filled by a weak, lax columella formed by a few straggling rods and attached to the inner ends of the septa. The interseptal loculi are mostly open. The upper margins of the septa are fenestrate. No pall can be discerned.

Measurements.—As follows:

Specimen	Height	Basal diameter	Maximum diameter
	mm	mm	mm
1 type.....	2	11 by 6	4 by 3
1 paratype.....	2	9 by 2	
1 paratype.....	2	4 by 2	4 by 2

Type.—U. S. N. M. no. 7423.

Paratype.—U. S. N. M. no. 7423, specimen 2.

Occurrences.—The type comes from a limestone in the Camoridge-Catawpa railway cut (Treadmann collection). Specimen 2 is from the *Actinopteria* beds east of Smithville (Mudley collection). Specimen 3 is from the Providence shales, underlying the redistal limestone, at Providence, near Port Antonio, Jamaica (Treadmann collection).

Remarks.—Worn specimens of this species look very much like *Actinopteria*, but the polygonal, noninserted calices, as well as the structural features, indicate a position in *Fenestropora*, the number of septa removing it from *Pecten*. The species, however, shows few affinities with the Senonian and Maestrichtian species of *Fenestropora* (*Leptorthis*), nor is it related to *F. rosarium* (Trinca) from which it can be distinguished by its smaller calices and fewer septa, with apparently no pall. It is probably nearer to the species enumerated from the Cenomanian of Bohemia by Bernard (1903, pp. 126, 128). A summary of the salient features of these forms, together with the Jamaican species, follows:

Species	Diameter of calices	Number of septa	Pall
	mm		
<i>F. rosarium</i> Berns.....	1.5	0-24	Not the pall.
<i>F. lezinsii</i> Berns.....	1.0	3-10	1-2, irregular.
<i>F. treadmanni</i> , new.....	1.0	0-3	None?

CORALS FROM THE TRECHMANN COLLECTION FROM THE LOWER
Eocene RICHMOND FORMATION OF JAMAICA

Genus *STILOPORHORA* Schweigger, 1824

STILOPORHORA species 1

Specimen.—U.S.N.M. no. 4921.

Occurrence.—The specimen, which has been rolled, comes from the conglomerate of the Richmond beds at Port Maria and may be derived (Cratichneumon Trechmann collection).

Remarks.—One specimen, while it undoubtedly represents a new species, is not named at present because of the imperfect state of the material. It is a curved subcylindrical fragment of a corallum, 41 mm in length, with diameter of 13 by 15 mm. The surface is much worn, and the characters of the calices and surface of the coenenchyme cannot be determined. The corallites are small, averaging 0.75 mm in diameter, distant 0.5 to 1 mm. Septa, 4 in number, attached to the columella; secondaries obsolete or not preserved in the specimen. The columella is large, styliform, and much thickened below the bottom of the calice. Coenenchyme dense.

STILOPORHORA species 2

Specimen.—U.S.N.M. no. 4922.

Occurrence.—The specimen occurs with the preceding one, in the conglomerate of the Richmond beds at Port Maria, Jamaica (Trechmann collection).

Remarks.—Another fragment from the Trechmann collection is placed with some doubt in this genus. It is part of a flattened branch or expansion of a corallum, 15 mm wide, 26 mm long, and 3 mm thick. The surface is badly worn. The corallites range from 0.5 to 1 mm in diameter, bounded by a solid astrucal wall. Septa, 12 in number, 4 of them rudimentary, the rest well developed and reaching to the columella. Columella styliform, small. The astrucal merge with a porous, reticulate coenenchyme, which is divided by a ridge extending midway between the corallites.

CORALS FROM THE TRECHMANN AND MATLEY COLLECTIONS.
FROM THE MIDDLE EOCENE YELLOW LIMESTONE OF JAMAICA

Family SERIATOPORIDAE Milne Edwards and Haime

Genus STYLOPHORA Schweigger, 1819

STYLOPHORA CAMBRIDGENSIS, new species

PLATE 4, FIGURES 3, 4

Description.—Corallum branching, basal portion unknown. Branches small, compressed or cylindrical. Calices small, superficial, ranging in diameter from 0.75 mm in the younger ones to 1 mm in older calices, spaced 0.25 to 0.5 mm apart. Septa, 12 in number, the six primaries distinct, well developed, extending to the columella, equal in size, and often exsert above the calicular margins; secondaries very short or rudimentary, present as mere ridges in the younger corallites. The columella is small, styliform, tubercular, not attaining the same height as the upper margins of the primary septa. The coenenchyme is dense, its surface covered with small tubercular granulations, which may be so arranged as to form an indistinct median ridge. The size of the branches varies from a diameter of 6.5 mm, in the more cylindrical ones, to 6 by 10 and 9 by 11 mm, in the more compressed ones.

Type.—U.S.N.M. no. 44283.

Occurrence.—The five specimens come from the Yellow limestone in the Cambridge district (Trechmann collection).

Remarks.—This species is closely related to *S. compressa* Duncan (1873, p. 551), a species occurring in the upper Eocene of St. Bartholomew, and may be possibly only a variety, but the more closely set, nonsalient calices, separated by a more strongly granular coenenchyme with a faint median ridge, appear sufficient to separate this Jamaican form.

Duncan (1865, p. 8) identified a *Stylophora* from the Richmond beds of Port Maria with *S. contorta* (Leymerie), a European species, which might be the same as the present species, but it is certainly not identical with Leymerie's species as it is described by Milne Edwards and Haime (1857, p. 135). Duncan's specimen might also be identical with our *Stylophora* species a, which comes from the same horizon at the same locality.

Family ASTROCOENIIDAE Koby

Genus ASTROCOENIA Milne Edwards and Haime, 1848

ASTROCOENIA JAMAICAENSIS, new species

PLATE 4, FIGURE 12

Description.—Corallum more or less massive, upper surface irregularly convex, sending up short protuberances. Corallites polygonal, closely fused by their walls in the lower part of the corallum, but often becoming slightly separated and cylindrical on the apices of the protuberances. Calices shallow, polygonal or circular in shape, separated by the fused corallite walls on which the upper ends of the septa of adjoining calices meet, producing low granulations or spines. Septa, 20 in number; 10 much larger than the rest and extending to the columella, the others more or less rudimentary. They are slightly granulate laterally, and the upper margins, which slope at first gently, then abruptly, toward the columella, are very lightly dentate. The columella is styliform, appearing in the bottom of the calice as a round or slightly compressed tubercle. Dissepiments sparsely developed.

Measurements.—As follows:

Specimen	Length	Width	Height	Calices	
				Maximum diameter	Minimum diameter
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1 (type).....	83	59	50	4	2
2 (paratype).....	15	13	22	4	2
3 (paratype).....	20	12	32	3	2

Specimen 1 represents a nearly complete corallum, whereas 2 and 3 are protuberances from a larger specimen.

Type.—U.S.N.M. no. 44284.

Occurrence.—Specimen 1 comes from the *Velates schmideliana* bed of the Cambridge formation at Spring Mount; specimens 2 and 3 are from the Yellow limestone in the Cambridge district (Trechmann collection).

Remarks.—This species is readily distinguished from the other species of this genus of the West Indian Tertiary, except *A. decaturensis* Vaughan (1919, p. 348) (lower and middle Oligocene), by the constant decamerall arrangement of the septa. In *A. decaturensis* the arrangement is usually octamerall, as in the other species of the West Indies, but it may be decamerall occasionally. Comparison with some other decamerall species follows:

Species of <i>Astrocoenia</i>	Horizon	Locality	Diameter of calices	Septa
<i>blanfordi</i> Duncan	Lower Eocene.....	Sind.....	<i>Mm</i> 2 -4.5	10/10
<i>clautensis</i> Dainelli.....	Eocene.....	Italy.....	2.5-3.5	10/10
<i>spongilla</i> Oppenheim.....	Middle Eocene.....	Bosnia.....	1 -2	10/10
<i>jamaicaensis</i> , new.....do.....	Jamaica.....	2 -4	10/10

Family FAVIIDAE Gregory

Genus ANTILLOPHYLLIA Vaughan, 1932 (=ANTILLIA of authors)

ANTILLOPHYLLIA (?) species

Specimen.—U.S.N.M. no. 44285.

Occurrence.—In the Yellow limestone at Spice Grove, Manchester Parish, Jamaica (Matley collection).

Remarks.—A single poorly preserved specimen is very doubtfully referred to this genus. It is a large corallum, subcylindrical or subcornute, curved, measuring 65 mm in length, with a maximum diameter near the top of 43 mm. The calice is filled with a tough matrix, and the upper edges of the septa are concealed for the most part, although a portion of one appears to be dentate, but the characters of the dentations cannot be determined. The exterior is devoid of an epitheca, which may have been worn away, and the costae, united by some exotheca, alternate in size and appear to be granulate or beaded on their edges. The wall is not distinct but is apparently solid. The septa are of medium thickness, laminar, imperforate, 90 to 100 in number, half of them extending to the center, where they unite with the large spongy columella. Endotheca abundant.

Family AGARICIIDAE Verrill

Genus ANTILLOSERIS Vaughan, 1905

ANTILLOSERIS CANTABRIGIENSIS (Vaughan)

Turbinoseris cantabrigiensis VAUGHAN, 1899, p. 245, pl. 40, figs. 5-7.

Antilloseris cantabrigiensis VAUGHAN, 1919, p. 194.—FELIX, 1925, p. 144.

Idotypes.—U.S.N.M. no. 44286.

Occurrence.—In a bed of small corals in the Yellow limestone in a road cut on the Rock River main road near Beckford, Clarendon Parish, Jamaica (Matley collection).

Remarks.—Twenty specimens from the Matley collection have been identified by Dr. Vaughan with his species. Their measurements are as follows:

Specimen	Height	Maximum diameters
	<i>Mm</i>	<i>Mm</i>
1.....	9.0	6.5 by 7.0
2.....	11.5	8.0 by 8.5
3.....	17.0	6.5 by 10
4.....	18.5	8.0 by 9.5
5.....	20.5	9.0 by 10
6.....	21.0	7.0 by 8.0
7.....	22.0	8.0 by 9.0
8.....	23.0	6.0 by 11.5
9.....	25.0	6.0 by 9.0
10.....	25.5	9.5 by 11.0
11.....	26.5	9.0 by 10.0
12.....	26.0	6.0 by 10.0
13.....	27.0	7.5 by 10.5
14.....	26.5	7.5 by 9.5
15.....	27.5	10.0 by 11.5
16.....	39.0	10.0 by 11.0
17.....	22.5?	6.0 by 11.0
18.....	24.0?	9.0 by 12.0
19.....	26.0?	9.0 by 10.5
20.....	22.5?	9.0 by 12.0

(The last four specimens are imperfect, the bases having been broken off.)

From this tabulation it will be seen that in this species lateral growth ceases after a maximum diameter of 9–10 by 10–11 mm has been reached, although the height may extend to as much as 39 mm. (Those specimens having diameters greater than the maxima recorded have been laterally compressed and distorted.)

ANTILLOSERIS JAMAICAENSIS (Vaughan)

Turbinoseris jamaicaensis VAUGHAN, 1899, p. 246, pl. 40, figs. 8–10.

Antilloseris jamaicaensis VAUGHAN, 1919, p. 194.—FELIX, 1925, p. 144.

Homeotype.—U.S.N.M. no. 44287.

Occurrence.—In the Yellow limestone on the Nottingham road near the turn to Gentle Hill, Manchester–St. Elizabeth boundary, Jamaica (Matley collection).

Remarks.—One specimen is referred to this species. It is considerably larger than Vaughan's figured specimen but fits his description of the internal structure well. It is much larger than any of the specimens referred to *A. cantabrigiensis* and measures: Height, 47 mm; maximum diameters, 14.5 by 17.5 mm.

ANTILLOSERIS species

PLATE 4, FIGURES 8–10

Description.—Corallum simple, short, conical, slightly compressed. Calice deep. Exterior of corallum costulate and devoid of an epi-

theca. Wall indistinct, perforate, and synapticate. Septa numerous, thin, imperforate, in five complete cycles and part of the sixth, the fifth and sixth cycles often uniting, the rest free at their inner ends, their upper margins with prominent dentations and their sides granulate, united by numerous synapticalae. The septa of the first two cycles are equal, more prominent than the rest in the calice, their inner ends sometimes uniting in the center.

Measurements.—The specimen measures: Height, 6.5 mm; diameters, 9.25 by 10.5 mm; depth of calice, 3.25 mm.

Specimen.—U.S.N.M. no. 44288.

Occurrence.—In the Yellow limestone on the bridle trail near Whitney Valley, $1\frac{1}{8}$ miles from Peace River, Clarendon Parish, Jamaica (Matley collection).

Remarks.—The preceding is a description of a small coral occurring with *Eupsammia clarendonensis* in the Peace River district and of which there is one specimen in the Matley collection. It probably represents a new species, but owing to the lack of other and more satisfactory specimens, it is not now named. It is distinguished from the other species of this genus occurring in the Eocene of the West Indian region by its relatively broad, low shape and deep calice; most of the species of the genus are taller, more cylindrical forms, except *A. cyclolites* (Duncan) of the upper Eocene of St. Bartholomew, which is much broader and flatter. *A. antillarum* (Duncan) approaches the Jamaican form but has a more compressed corallum.

Genus TROCHOSERIS Milne Edwards and Haime, 1849

TROCHOSERIS (?) species

Description.—Corallum simple, apparently free, with a broad, sub-cylindrical, slightly convex base, becoming compressed and elliptical in outline but not flaring outward near the calice. Wall apparently solid. Costae not preserved in the specimen. Calice superficial, with a long, narrow, shallow fossette. Septa, about 200 in number, strongly exsert, imperforate, unequal, laterally granulate, upper margins not preserved. The first four cycles are equal, much thicker than the rest, and extending to the center. Those of the fifth cycle also extend to the center. The remaining septa are thin and extend one-third to two-thirds of the distance to the columella. Columella thin, lamellate, spongy, papillate on top, not prominent in the fossette. Synapticalae well developed, abundant. Endothecal dissepiments developed in the vicinity of the wall.

Measurements.—The specimen measures: Height, 34 mm; basal diameters, 40 by 45 mm; calicular diameters, 30 by 59 mm.

Specimen.—U.S.N.M. no. 44289.

Occurrence.—Probably from the Yellow limestone at Williamsfield, St. James Parish, Jamaica (Matley collection).

Remarks.—This specimen very likely represents a new species but it is in very poor condition as a result of much surface wear, which has almost destroyed the wall and has obliterated the upper margins of the septa. The generic affinities are doubtful until better specimens can be found.

Family EUPSAMMIDAE Milne Edwards and Haime

Genus EUPSAMMIA Milne Edwards and Haime, 1848

EUPSAMMIA CLARENDONENSIS, new species

PLATE 4, FIGURES 6, 7; PLATE 5, FIGURE 6

Description.—Corallum simple, free, small, short, turbinate or subhemispherical, with a shallow, slightly elliptical calice and a nipple-shaped scar of early attachment at the base. The exterior is not well shown by either of the specimens, but no epitheca appears to have been present. The wall is porous, synapticulate, and of some thickness. The septa are imperforate and laminar, with a few scattered pores. Their arrangement is characteristic of the Eupsamids, the septa of the first two cycles being free and straight, extending to the center; the septa of the fourth cycle fusing to the third cycle near the columella, producing a delta-shaped group of septa; and the fifth cycle fusing to the fourth. About three-fourths of the sixth cycle is developed. The columella is well developed, spongy, and joined to the inner ends of the first three cycles of septa. The distal ends of the septa are lost in the synapticular tangle of the wall. The synapticulae are well developed and are most abundant near the wall. There are no dissepiments.

Measurements.—As follows:

Specimen	Height	Diameters
	<i>Mm</i>	<i>Mm</i>
1 (type).....	6.5	10.5 by 12
2 (paratype).....	6.5	9 by 10

Type.—U.S.N.M. no. 44290.

Paratype.—U.S.N.M. no. 44291.

Occurrence.—In the Yellow limestone on Peace River, Clarendon Parish (type specimen); and on the bridge trail near Whitney Valley, $1\frac{1}{8}$ miles from Peace River, Clarendon Parish (Matley collection).

Remarks.—This species is readily distinguished by the low sub-hemispherical corallum with a small point of early attachment and by the septal arrangement. The only American species to which it might be related is *E. conradi* Vaughan (1900b, p. 183) from the upper Eocene of Virginia and Mississippi, which has a much thicker wall and four cycles of septa.

Family ACROPORIDAE Verrill

Genus DENDRACIS Milne Edwards and Haime, 1849

DENDRACIS CANTABRIGIENSIS Vaughan

Dendracis cantabrigiensis VAUGHAN, 1899, p. 248, pl. 41, figs. 3, 5, 6 (*non* 4); 1919, p. 194.—FELIX, 1925, p. 268.

Occurrence.—Specimen 1 is from the Yellow limestone at Spring Mount; specimens 2 and 3 are from the same formation in the Cambridge district, Jamaica (Trechmann collection).

Remarks.—Two small fragments and a small block containing several fragments, all from the Trechmann collection, have been identified by Dr. Vaughan with his species. There are no notable departures from his published description.

Measurements.—As follows:

Specimen	Length	Diameter	Diameter of calices
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1.....	24	4	1.0
2.....	30	5	1.3
3.....	37	4 by 6	1.0

Genus ACTINACIS d'Orbigny, 1849

ACTINACIS SAWKINSI, new species

PLATE 4, FIGURE 5; PLATE 5, FIGURE 7

Description.—Corallum massive, upper surface convex, marked by low rounded gibbositities, under surface irregularly concave, the whole being composed of superimposed laminar layers. Corallites small, 1.2 to 1.5 mm in diameter, separated by less than their own diameter of coenenchyme. The coenenchyme is composed of perforate septo-costae, which are united by synapticulae to form a porous reticulum. Corallite walls distinct, very porous, formed by a single ring of large synapticulae connecting the thickened outer trabecular elements of the septa. The septa are straight, well developed, less in thickness than the interseptal loculi; they are al-

ways 24 in number, forming three complete cycles. The septa of the first cycle are free, extending nearly to columella, two larger ones lying in the same plane and dividing the corallite. The inner ends of the third cycle fuse near or at the inner ends of the second cycle, which is equal in length to the first. The full number of pali is 12, arranged in two crowns, but several of them may be missing. The interseptal loculi are open. The columella is styliform, well developed, often slightly compressed in the same plane as that of the two directive septa.

Measurements.—As follows:

Specimen	Length	Width	Maximum height
	<i>Mm</i>	<i>Mm</i>	<i>Mm</i>
1 (type).....	114.5	45	44
2 (paratype).....	76	68	39

Type.—U.S.N.M. no. 44294.

Occurrence.—Both specimens are from the *Velates schmideliana* bed of the Yellow limestone at Spring Mount, Jamaica (Trechmann collection).

Remarks.—This species may be distinguished from *A. alabamiensis* (Vaughan) (1900b, p. 194; 1919, p. 486) (middle Oligocene), to which it is probably related, by the presence of three complete cycles of septa and styliform columella, *A. alabamiensis* having but 20 septa and a columella composed of septal processes.

ACTINACIS BARRETTI, new species

PLATE 4, FIGURES 1, 2

Description.—Corallum branching, basal portion unknown, the branches compressed and blunt. The average thickness is 6 mm, and the width varies from 7 to 8 mm. The type represents a branch that bifurcates 32 mm from the lower extremity, and each of the branches thus produced again divides. The corallites are small, not more than 1 mm in diameter, slightly projecting, and separated by less than their own diameter of coenenchyme. The coenenchyme is perforate, synapticalae uniting the perforate septo-costae to form a porous reticulum. Corallite walls very little developed, a few synapticalae forming a peripheral ring by uniting the swollen outer ends of the septa. Between the wall and the surrounding coenenchyme is an interspace traversed by nothing except a very few trabecular expansions uniting the septa and septo-costae. The full number of septa is 24, arranged in three complete cycles as in *A.*

sawkinsi, except that 4 to 8 of them may be lacking in some calices. They are short, tapering rapidly from a considerable thickness at the wall to a fine inner edge. Those of the first cycle are equal and free and end in a crown of pali around the columella. The second cycle is joined near the inner ends by the third cycle and terminates in a second crown of pali just outside the first. The columella is a small columnar style in the center of the corallite.

Type.—U.S.N.M. no. 44295.

Occurrence.—In the Yellow limestone in the Cambridge district, Jamaica (Trechmann collection).

Remarks.—This species is distinguished from *A. sawkinsi*, with which it occurs, by its smaller corallites, by the narrow space around the corallites, and by the subnormal number of septa in many of the corallites. Its branching rather than massive growth-form is also a distinction.

Genus *ASTREOPORA* Blainville, 1830

ASTREOPORA WALLI, new species

PLATE 4, FIGURE 13

Description.—Corallum forming branches, which may be more or less palmate in form. Palmate portions about 10 mm thick. The basal part of one branch measures about 11 by 21 mm. The calices are not preserved in the specimens. The corallites are cylindrical or slightly compressed, averaging 1 mm in diameter, spaced about 0.3 mm apart. The septa are usually 6 in number, but a few rudimentary ones may also be developed. They are short, rarely extending more than halfway to the center of the corallite. At the periphery they are expanded to form the corallite wall, which is irregularly perforate. Septo-costae are present, corresponding to the septa, but not much developed and nonconfluent. There is no columella. Uniting the corallites are numerous irregular perforate tabulae forming a loose coenenchyme.

Type.—U.S.N.M. no. 44296.

Occurrence.—In the Yellow limestone in the Cambridge district, Jamaica (Trechmann collection).

Remarks.—This is the first species of *Astreopora* to be described from the Eocene of the West Indian region, although several have been noted from the Oligocene by Vaughan. It is distinguished from these later species by the smaller size of the corallites lighter coenenchyme, and lack of a columella.

Family PORITIDAE Dana

Genus GONIARAEA d'Orbigny, 1849

GONIARAEA CHRISTIANIAENSIS, new species

PLATE 4, FIGURE 11

Description.—The type is a small distal fragment of a branch measuring 17.5 mm in length and 4 mm in diameter. The calices are diamond shaped, shallow, looking upward toward the tip of the branch, and measuring 4 mm on the long diameter parallel to the axis of the branch and 2.75 mm on the shorter. The walls are thin, with acute upper edges. The septa number 12, all reaching to the columella. The columella is small, styloform, and much thickened below the calice. No pali can be discerned. The structure of the septa is obscure, but a section across one end of the branch shows them to be perforate.

Type.—U.S.N.M. no. 44297.

Occurrence.—In the Yellow limestone of the Christiania district, Manchester, Jamaica (Matley collection).

Remarks.—This species is very close to *G. clinactina* (Michelotti) of the middle Oligocene of Monte Grumi, specimens of which are in the National Museum, the only observable difference being in the slightly larger calices of the Jamaican form.

The single poorly preserved specimen upon which the species is based does not show the characters of the form so well as could be desired. The normal shape of the calices, that is, of the calices on the thicker main branches of the corallum, is probably not diamond shaped, but hexagonal or pentagonal, if we may judge from *G. clinactina*.

CORALS FROM THE TRECHMANN AND ROMANES COLLECTIONS
FROM THE SCOTLAND BEDS OF BARBADOS

Seven specimens of corals were collected by Dr. C. T. Trechmann from a fossiliferous conglomerate band (evidently Bed "b" of Trechmann's 1925 paper) in the Scotland beds of the Island of Barbados, British West Indies. These were submitted to Dr. T. W. Vaughan for determination and by him turned over to the author for description. The material from the Romanes collection consists of four specimens—three of *Madracis decactis* (Lyman) and one of *Trochocyathus* sp. All the specimens are fragmentary, and, while at least two new species are represented and possibly a third, none has been described as such.

The Scotland beds have been the subject of a paper by Dr. Trechmann (1925) in which he has tentatively established them as being

of middle or upper Eocene age. A still more recent paper by Dr. Matley (1932) considers the question of the age of these beds, and, after a summary of the evidence offered by various authorities, gives them an upper Eocene age. He lists the following preliminary determination of the corals by Dr. Vaughan:

Asterosmilia cf. *hilli* Vaughan.

Stephanocoenia (?) sp.

Madracis (?) sp.

Pavona sp.

(The *Stephanocoenia* ? sp. is discussed in the present notes as *Madracis decactis*.) He mentions also that R. B. Newton determined the coral genera *Paracyathus* and *Astrocoenia* in the Romanes collection. (In the present notes the *Paracyathus* is considered as *Trochocyathus* and the *Astrocoenia* as *Madracis decactis*.)

Though it is not the purpose here to enter any controversy regarding the age of the Scotland beds, the evidence given by these small collections of corals indicates an age younger than Eocene, perhaps early Miocene.

Genus MADRACIS Milne Edwards and Haime, 1849

MADRACIS DECACTIS (Lyman)

PLATE 4, FIGURE 16

Astraca decactis LYMAN, 1859, p. 260.

Madracis decactis VERRILL, 1864, p. 45.—GREGORY, 1895, p. 258, fig. 1.

Specimens.—U.S.N.M. no. 44301; Brit. Mus. (N.H.) nos. R29689, R29690, R29691.

Occurrence.—In a conglomerate band in the Scotland beds on the Spa Estate, 2 miles southwest of Bissex Hill, Barbados (Trechmann and Romanes collections).

Remarks.—Seven specimens are referred to this species. The calicular surface is not preserved in any specimen, but the internal structure corresponds exactly to that of specimens from the Miocene of the Dominican Republic in the National Museum. The corallites average 1.5 mm in diameter and are closely packed together. There are 10 well-developed septa that reach the columella and 10 rudimentary septa that appear on the interior of the corallites as spines projecting into the corallite cavity. The dissepiments are well developed and horizontal. The specimens represent fragments from larger coralla.

M. decactis ranges from Miocene⁴ to Recent.

⁴ Vaughan and Woodring, 1921, pp. 99, 133, 152, 157 (Miocene); p. 167 (Pleistocene).

MADRACIS (?) species

PLATE 4, FIGURES 14, 15

Description.—A fragmentary specimen is doubtfully placed in this genus. The branch is about 6.5 mm in diameter and is marked by what appears to be an axial corallite, a feature not present in *Madracis*. The calices are shallow, widely separated, and not projecting, except the axial corallites, which occupy the tops of conical protrusions indicating the formation of a new branch. Their diameter varies from 1.8 mm to 2 mm. There are 10 well-developed septa, which join the broad styliform columella. Between them are 10 very rudimentary septa. The surface of the coenenchyme between the corallites is not costulate but finely striate and granulate. The coenenchyme is very dense to a depth of 0.75 mm, the interior of the branch being cellular or open in the region of the axial corallite.

Specimen.—U.S.N.M. no. 44302.

Occurrence.—In a conglomerate band in the Scotland beds in the Spa Estate, 2 miles southwest of Bissex Hill, Barbados (Trechmann collection).

Remarks.—It is unfortunate that the single specimen of this interesting form is not more complete, because the apparent presence of an axial corallite separates it from the genera of the Seriatoporidae, the rest of the characters linking it to *Madracis*. If the axial corallite is really present it would indicate a new genus bearing approximately the same relation to *Madracis* as *Archohelia* does to *Oculina*.

Trechmann's *Stylococenia* (?) sp. (1925, pl. 24, fig. 47) appears to be a *Madracis*, but his figure is not clear enough to identify the species.

Genus TROCHOCYATHUS Milne Edwards and Haime, 1848

TROCHOCYATHUS (?) species

Specimen.—Brit. Mus. (N.H.) no. R296⁸8.

Occurrence.—In a conglomerate band in the Scotland beds on the Spa Estate, 2 miles southwest of Bissex Hill, Barbados (Romanes collection).

Remarks.—One specimen, placed doubtfully in this genus, is a portion of a conical corallum of a caryophyllid coral that has lost both calice and base. The exterior is worn away. The septa number 40 and appear to alternate regularly in size. The longer ones bear pali, which form two crowns around the columella. The columella is well developed and fascicular.

It is not unlikely that this is a species of *Paracyathus*, but the lack of a basal portion of the specimen prevents the settling of this point. *Paracyathus henekeni* Duncan (1863, p. 426) of the lower Miocene of San Domingo is a much smaller species.

Genus ASTEROSMILIA Duncan, 1867

ASTEROSMILIA species cf. A. HILLI Vaughan, 1919

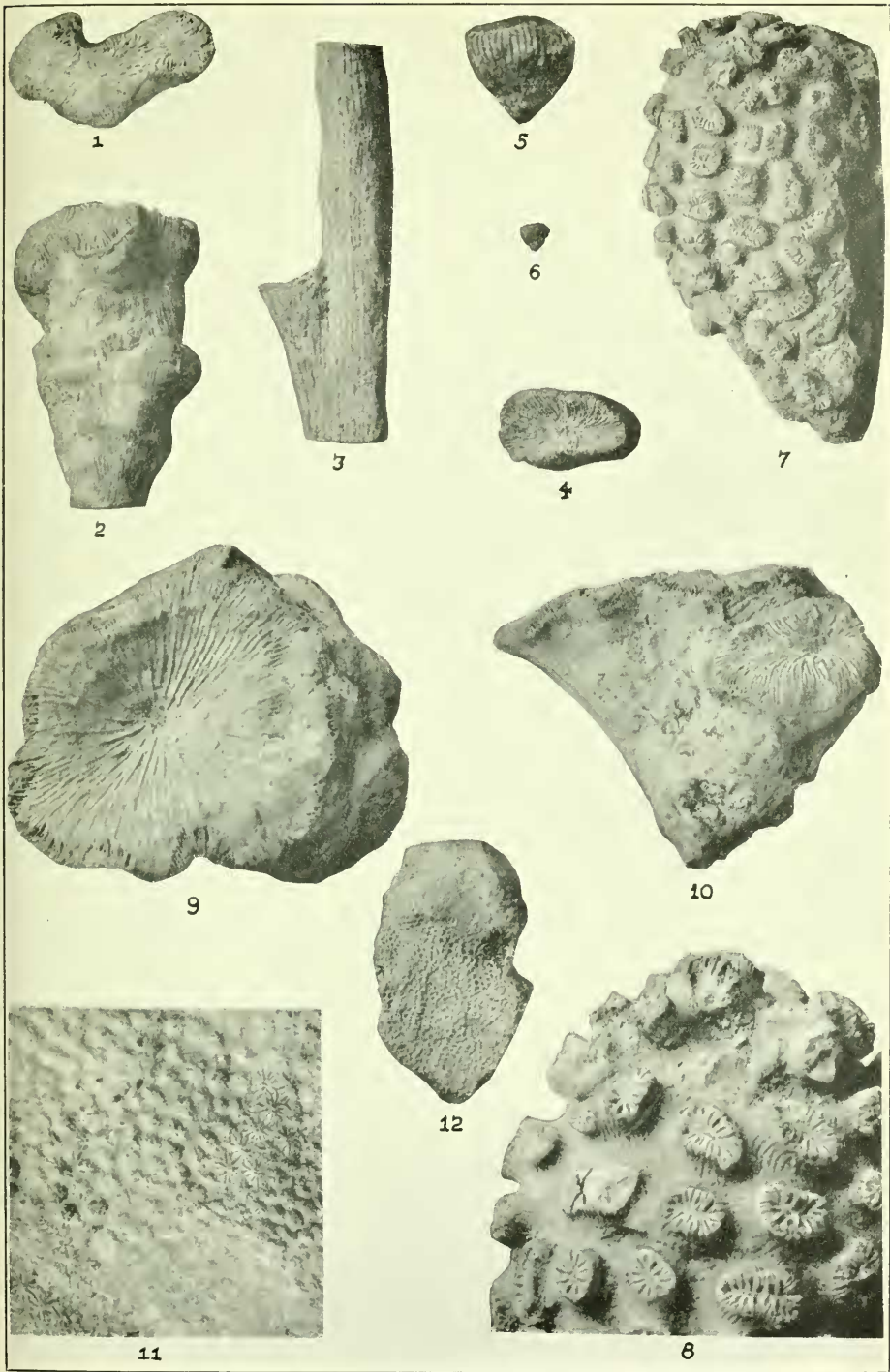
Specimen.—U.S.N.M. no. 44303.*Occurrence*.—In a conglomerate band in the Scotland beds on the Spa Estate, 2 miles southwest of Bissex Hill, Barbados (Trechmann collection).*Remarks*.—One specimen is placed in affinity with this species. The only differences between it and typical specimens from the Dominican Republic are that the wall is somewhat thicker and the costae more regularly alternating in size in the Barbados specimen.*A. hilli* Vaughan (1919, p. 355) occurs in the Miocene of Costa Rica, Jamaica, and the Dominican Republic.

Genus PAVONA Lamarck, 1801

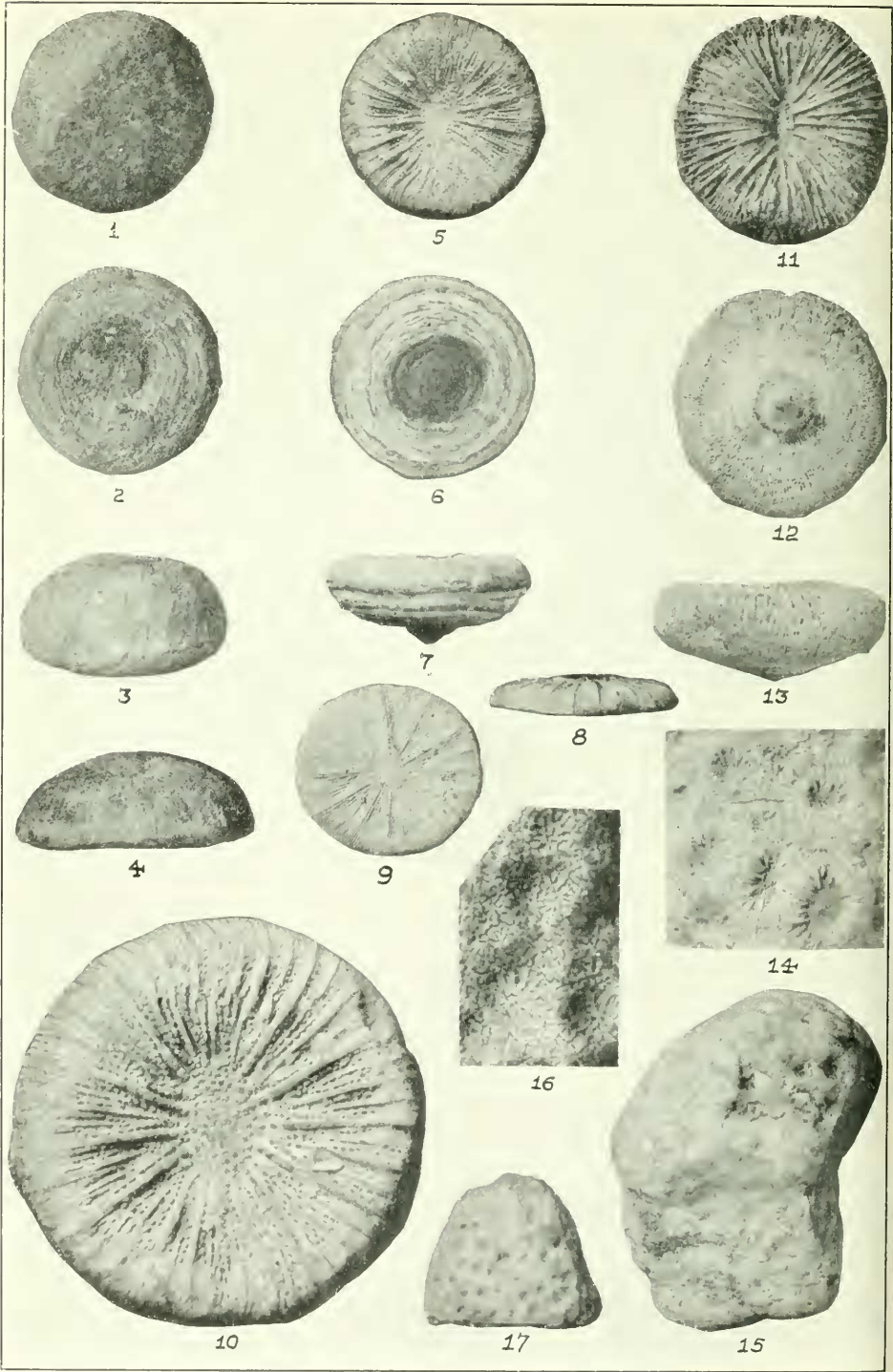
PAVONA species

PLATE 4, FIGURE 17

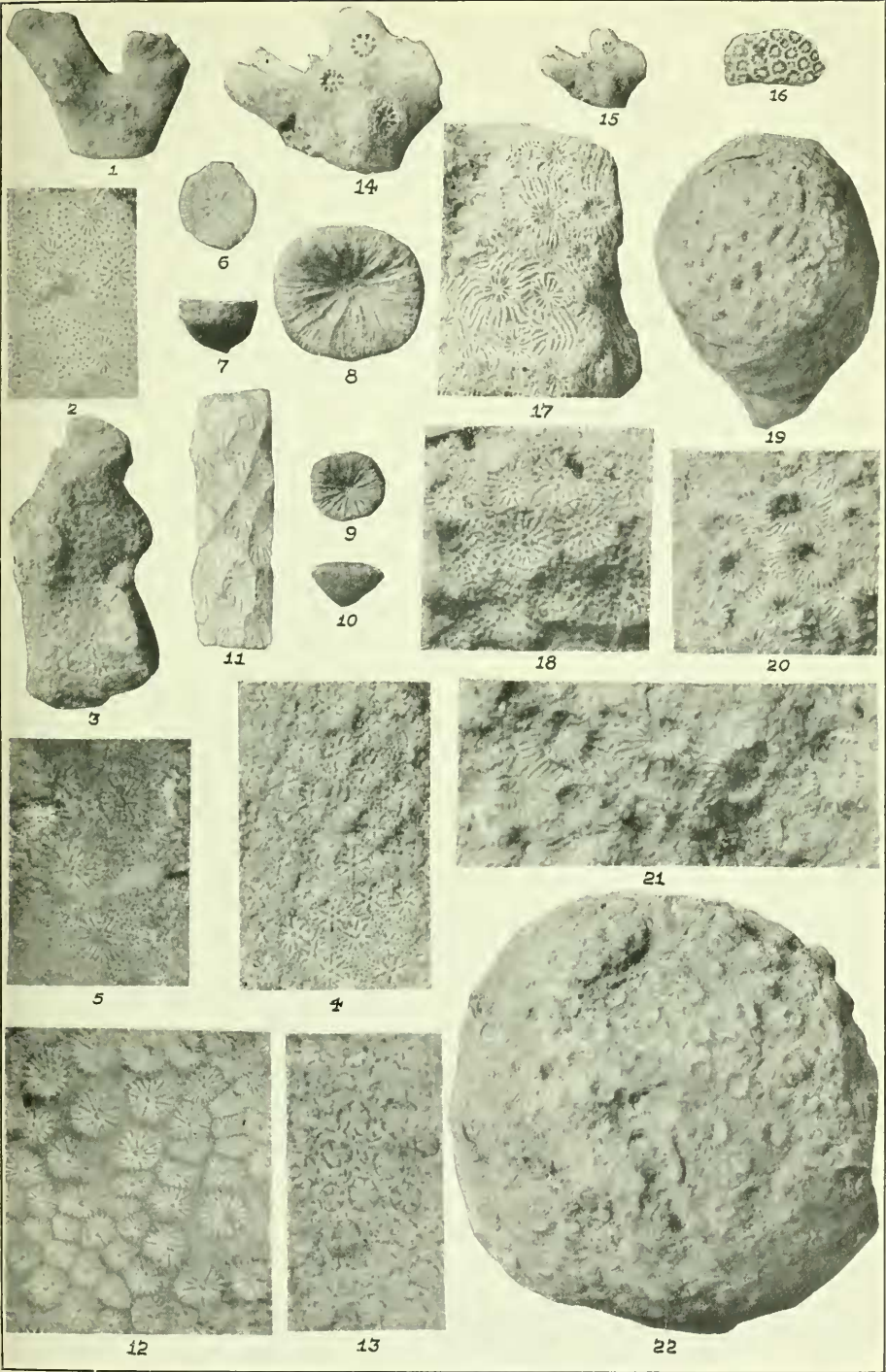
Description.—The specimen is a single much-worn fragment of a unifacial frond, measuring 20 by 25 by 12 mm. The noncalicular surface bears alternating costae numbering 8 to 10 in a space of 2 mm. The worn calicular surface bears scattered calices, which range from 1.5 to 2 mm in diameter, separated by a distance of 3.5 to 4 mm between centers, united by regularly alternating septo-costae. The centers are circumscribed by a ring of strongly developed synapticulae separating them from the intercorallite areas. Within the calices there are from 20 to 24 septa, about 10 of which extend to the columella. The columella is trabecular, formed by the fused inner ends of the longer septa.*Specimen*.—U.S.N.M. no. 44304.*Occurrence*.—In a conglomerate band in the Scotland beds on the Spa Estate, 2 miles southwest of Bissex Hill, Barbados (Trechmann collection).*Remarks*.—This specimen probably represents a new species of *Pavona*, but the material is too scanty for further treatment. *P. panamensis* Vaughan, from the upper Oligocene of the Canal Zone, differs by having larger calices in definite series with subequal, larger septo-costae. *P. pennyi* Vaughan, from the Miocene of Trinidad, has larger calices with fewer main septa and a larger total number of septa as well as a compressed styliiform columella.*Pavona* occurs in the upper Oligocene and Miocene of the Caribbean region and is living in the Indo-Pacific.



WEST INDIAN FOSSIL CORALS.
FOR EXPLANATION OF PLATE SEE PAGE 109.

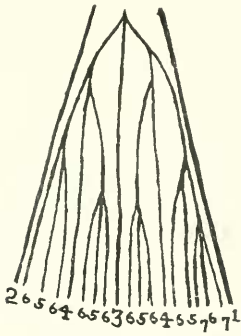


WEST INDIAN FOSSIL CORALS.
FOR EXPLANATION OF PLATE SEE PAGE 109.

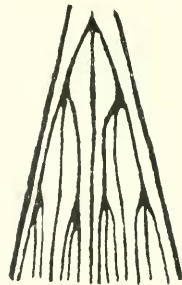


WEST INDIAN FOSSIL CORALS.

FOR EXPLANATION OF PLATE SEE PAGE 110.



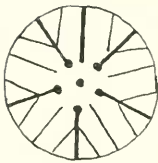
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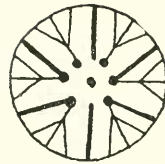
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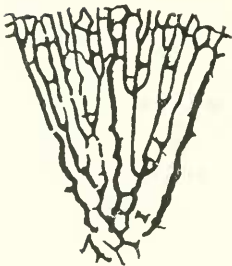
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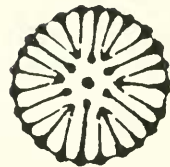
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WEST INDIAN FOSSIL CORALS.
FOR EXPLANATION OF PLATE SEE PAGE 116.